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The Growth of Renewable Energy Sector in Central Asia: Business Potential and Policy Support

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Central Asian states historically have been reliant on fossil fuels for energy production however the growing energy needs and climate mitigation commitments have pushed the region to reconsider their energy sector trajectories. Central Asia is endowed with huge natural resources and the renewable energy industry seems highly promising provided that the governments incentivize with good regulations and cooperate within the region. In fact the transition to renewable energy is not without hurdles. Various challenges i.e. limited access to long-term financing, lack of transparent, inadequate grid infrastructure and consistent regulations and institutional bottlenecks pose significant hurdles. This paper aims to investigate the investment landscape for renewable energy in three Central Asian countries i.e. Kazakhstan, Uzbekistan, and Kyrgyzstan, exploring the intersection of policy frameworks, foreign direct investment (FDI), and business environment factors. The research attempts to identify key enablers and barriers in the growth of renewable energy, to analyze policies and regulatory frameworks that incentivize investment in renewable energy, to assess the role of foreign direct investment (FDI) and international cooperation in shaping the renewable energy sector thus offering policy recommendations for accelerating a just and sustainable energy transition across the region. The trajectory of renewable energy investment in Kazakhstan, Uzbekistan, and Kyrgyzstan is shaped not by mere resource abundance, but also by the intricate interplay of institutional capacity, regulatory clarity, and the implementation of targeted policy frameworks. The research methodology is primarily qualitative in nature, employing explanatory and exploratory approaches to understand and explore the understudied aspects of the subject matter that is renewable energy sector, its potential, investments and policy .

Keywords: Renewable Energy, Kazakhstan, Kyrgyzstan, Uzbekistan, Regulatory Framework, Foreign Investment

Renewable energy comes from natural sources that are renewed within a human timescale, for example solar, wind, hydro and geothermal power. While the world dealing with bigger environmental and energy issues, renewable energy is now a main part of sustainable development and climate action (Huaping et al., 2019). There is tremendous business opportunities in renewable energy sector, since it provides a way to invest in technology, infrastructure and related services to boost the economy, generate employment and encourage new ideas (Chen, 2014). Central Asia has considerable growth potential in the renewable energy sector for example, Kazakhstan and Uzbekistan benefit from vast steppes and arid zones with high solar irradiance while mountainous Kyrgyzstan and Tajikistan have ample potential for expanding small hydropower projects. Technical assessments from IRENA (2020) and the World Bank (2022) estimate that Kazakhstan and Uzbekistan possess over 3,000 GW of solar potential and 300 GW of wind potential, while Kyrgyzstan is endowed with over 140 TWh/year of economically viable hydropower capacity (UNDP, 2022). However it is government incentives,

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good regulations and the cooperation of nations that help make the renewable energy market safe, attract investment and encourage companies to be actively involved.

The research work aims to investigate the investment landscape for renewable energy in Central Asian countries i.e. Kazakhstan, Uzbekistan and Kyrgyzstan, exploring the intersection of policy frameworks, foreign direct investment (FDI), and business environment factors. By analyzing and comparing these three countries, the research seeks to identify key enablers and barriers in the growth of renewable energy, offering policy recommendations for accelerating a just and sustainable energy transition across the region. The study also aims to bridge existing knowledge gaps by systematically applying institutional theory to compare how institutional capacity, regulatory clarity, and policy implementation directly shape the renewable energy investment landscape by providing a comparative, multi-dimensional analysis of renewable energy investment dynamics in Central Asia particularly in Kazakhstan, Kyrgyz Republic and Uzbekistan. The research work also attempts to achieve key objectives such as to evaluate the current state of renewable energy infrastructure in Kazakhstan, Uzbekistan and Kyrgyzstan, to analyze policies and regulatory frameworks that incentivize investment in renewable energy, to assess the role of foreign direct investment (FDI) and international cooperation in shaping the renewable energy sector and to examine the broader business environment in the three Central Asian Republics that affects investor confidence and project implementation.

Research objectives are achieved by answering the following research questions: What is the current state of renewable energy infrastructure in Kazakhstan, Uzbekistan and Kyrgyzstan? What policies are in place to support or incentivize investment in renewables? What is the role of foreign direct investment (FDI) and international cooperation (e.g. World Bank, ADB)?, and how does the business environment in the three Central Asian Republics impact investor confidence in the renewable energy sector? The research methodology is primarily qualitative in nature, employing explanatory and exploratory approaches to understand and explore the understudied aspects of the subject matter that is renewable energy sector, its potential, investments and policy frameworks through logical thinking, scientific abstraction, analysis, re-interpretations, synthesis, induction and deduction. Secondary sources have been used to interpret, reinterpret and evaluate the subject matter using the content analysis method to draw appropriate conclusions.

The transition to renewable energy in Central Asia has become a growing area of scholarly and policy interest, reflecting a broader regional shift toward sustainable energy systems. The literature on this subject encompasses studies on technical potential, policy frameworks, investment climate, and institutional capacity, offering valuable insights into the region's renewable energy trajectory. Literature review reveals several recurring themes: the need for consistent and transparent policy frameworks, the importance of international partnerships and the challenge of integrating variable renewables into existing grids. However, there are gaps in comparative studies across Central Asian states especially regarding private sector participation and sub-national implementation. Furthermore, few studies provide a comprehensive analysis that combine policy review, investment trends, and investor perceptions in a single framework. Literature on the subject matter suggests that while Kazakhstan and Uzbekistan have made considerable progress in attracting renewable energy investment, Kyrgyzstan remains constrained by institutional and infrastructural challenges. The transition to renewable energy is not without hurdles. Various challenges i.e. limited access to long-term financing, lack of transparent, inadequate grid infrastructure, inconsistent regulations and institutional bottlenecks pose significant hurdles. Nevertheless diversifications of energy sources in the face of growing domestic energy needs accompanied by global momentum toward sustainable energy, climate change and its mitigation have pushed Central Asian states to reconsider their energy sector trajectories.

Current State of the Energy Infrastructure in Central Asia

Contemporary Central Asia's energy landscape has been shaped by its Soviet legacy marked by centralized planning, outdated infrastructure, and limited market incentives. Overland (2011) outlines how post-Soviet institutional inertia has complicated reform processes, though recent policy shifts signal a departure from fossil-fuel dependency. The decades' old obsolete and outdated energy infrastructure in Central Asia including relatively developed Kazakhstan where 44% energy infrastructure is more than 30 years old poses challenges in transition to renewable energy. Due to the rich resource endowment, the region has been heavily reliant on fossil

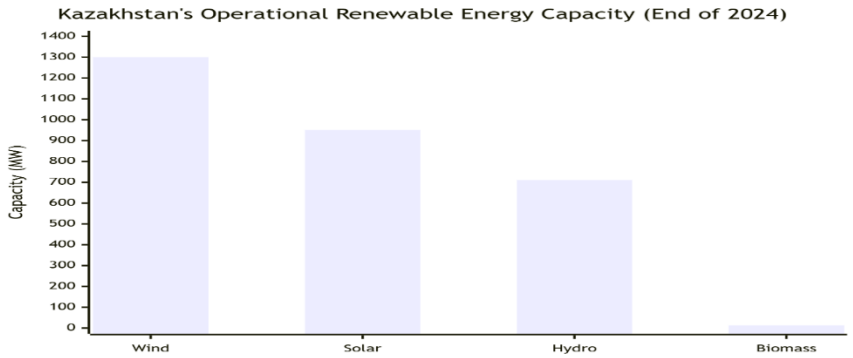
fuels, particularly oil and natural gas in Kazakhstan, Turkmenistan, Uzbekistan and hydropower in Kyrgyzstan and Tajikistan. This fossil-fuel dependence has shaped not only the energy infrastructure but also the economic structures and geopolitical alignments of these countries. According to International Energy Agency, coal contributes 51% and crude oil contributes 54% to Kazakhstan's energy mix (IEA, 2022). According to the Energy Resource Guide, coal has the major share 64.7% in the energy mix of Kazakhstan while hydropower contributes around 12.3% to the total power generation (Energy Resource Guide, 2021). The current state of renewable energy infrastructure in Kazakhstan seems promising though with a small share in total energy mix. By the end of 2024, there were total 148 renewable energy plants operational in Kazakhstan with a total capacity of 2903.7 MW making 6.67% share in total energy generation (Astana Times, 13 December, 2024). These included 59 wind farms, 46 solar power plants, 40 hydroelectric plants, and 3 biomass plants. It is evident that Kazakhstan needs to move from coal and other fossil fuel energy sources to renewable energy sources in order to reduce carbon emissions in a cost-effective way.

Uzbekistan has rapidly enhance its share of renewable in energy mix during the last year or so though still heavily dependent on fossil fuel where gas generated energy makes roughly 75% of the energy mix, oil and oil products makes around 14% while renewable energymakes11% by 2026 (World Bank Group, n.d.). By the end of 2024, solar and wind power plants produced 4.5 billion kWh electricity in the Republic and attracted nearly $3 billion foreign investment. According to the Uzbekistan's Ministry of Energy, 2331 solar power plants were installed during the first half of 2025 with a total capacity of 191.6 MW. Karakalpakstan, Navoi region and Bukhara with steady wind currents have been identified as ideal for wind power plants. Unlike its neighbors, Kyrgyzstan derives over 90% of its electricity from hydropower (IEA, 2021). Hydropower generation remains the most exploitable renewable energy source for Kyrgyz Republic having the highest hydro power potential as both the main rivers of Central Asia i.e. Amu Darya and Syr Darya originate in the mountains bordering Kyrgyzstan. However the lower riparian countries Uzbekistan, Turkmenistan and Kazakhstan are heavily dependent on these two rivers for irrigation purposes. Therefore development of small scale and micro hydro power plants may properly address the cross border water security issues and energy balance for Kyrgyzstan and Tajikistan as suggested by Azimov, Ulugbek and Nilufar Avezova (2022). Central Asian Republics through developed renewable energy sources aim to avoid depleting valuable sources, to limit greenhouse emissions and global salt migration and to avoid wastages in energy production (Tursunaliyevna et al., 2025). The renewable energy sources hold immense potential in Central Asia due to the region's favorable geographical and climatic conditions. Recognizing this potential, governments in the region have initiated policy frameworks, introduced investment incentives and partnered with international financial institutions and private investors to support the growth of renewable energy.

Kazakhstan: Policy Leadership and Market Innovation

Renewable energy policy and market progress in Kazakhstan are being led by the country's focus on eco-friendly growth and a wide-ranging economy (UNDP, 2022). Kazakhstan-2050 sets a long-term goal for renewable sources to provide half of the nation's electricity by 2050 and it hopes to get to 15% by 2030 (Shustov, 2019). One of the ways Kazakhstan has met its goals is by moving from feed-in tariffs to holding auctions which has also attracted plenty of investment by foreign countries in wind and solar projects. Steps like constructing green hydrogen facilities reveal how committed the country is to clean energy. Because of the Astana International Financial Centre (AIFC) which is now open, Kazakhstan is becoming the leading country in green finance and attracting investments for green projects. These efforts demonstrate how Kazakhstan is working actively towards greener energy sources and a growing economy. According to a Kazakh national source, 98% of Kazakhstan's energy mix is made of fossil fuels i.e. 38% of coal, 36% of oil and 24% of natural gas (Sembayeva, 2024).

The geographic and climatic conditions of Kazakhstan make it suitable for sustainable wind power and solar energy generation in addition to rich uranium deposits for civil nuclear energy production in future. Kazakhstan plans to develop three civil nuclear power plants in collaboration with Russia's Rosatom and China's National Nuclear Corporation (Sukhankin, 27 June, 2025). As per the Asian Development Bank Institute working paper, Kazakhstan has been the most capable to develop renewable energy resources (Shadrina, 2019).



The Concept for the Transition to a Green Economy' of the Republic of Kazakhstan provides the policy framework for the development of renewable energy sector which envisions and aims to enhance the share of renewable energy comprising solar, wind, hydro and nuclear in the total energy mix up to 15% by 2030 and 50% by the year 2050 (Chikanayev, 2022).Kazakhstan needs to invest at least 1% of its GDP or 3 to 4 billion US dollars every year to enhance the share of renewable energy to 50% by 2050 with enhanced share of wind and solar energy to 39%, nuclear and hydroelectricity to 14% while reducing coal powered generation to 31%(Aminjonov, 2020).

The Law No. 165-IV of July 04, 2009 of the Republic of Kazakhstan defines the goal, forms, direction and mechanisms for supporting renewable energy sources and their utilization while the Law No. 588-II dated July 09, 2004 is the key key regulatory framework governing electricity supply in Kazakhstan. (Chikanayev, 2022).

Kazakhstan has the most liberalized national electricity market in Central Asia. Kazakhstan, having one of the world largest uranium deposits, plans to move forward with nuclear energy plant consortiumduring 2025.The Republichas emerged as a regional leader in renewable energy due to its proactive policy stance and relatively stable investment climate.To attract foreign investment for the development of renewable sources, Kazakhstan has established an electronic auction systemensuring open and transparent implementation process.The "Green Economy Concept" (2013) sets a target of 50% of electricity from renewable sources by 2050. Studies by Gordeeva et al., (2022) and Boute (2019) highlight Kazakhstan's implementation of feed-in tariffs (2013–2017), transition to reverse auctions (2018 onward), and green certificates as key innovations in market design.The State-Owned Development Bank of Kazakhstan and the Asian Development Bank, the European Bank for Reconstruction and Development (EBRD), the Asian Infrastructure Investment Bank, the Eurasian Development, the Industrial and Commercial Bank of China and the Chinese Development Bank have been the major financiers in the large-scale renewable projects of Kazakhstan.

The EBRD (2021) has supported several projects under public-private partnerships, while German, Chinese, and UAE investors have participated in tenders.By 2026, China has invested $2 billion in Kazakhstan's solar and wind projects including Aktobe, Karaganda, and Almaty regions. China is dominating Central Asian renewables market with high-tech components and expertise to overcome production overcapacity at home while developing infrastructure in the region.In cooperation with the EBRD, Kazakhstan commissioned the largest solar energy plant in Central Asian during 2019 ((Shadrina, 2019).The green energy sector has been prioritized by the Republic having huge potential for attracting foreign direct investment.Foreign investment in large-scale renewable energy projects is governed by the Inter-governmental Agreement (IGA) between the government of Kazakhstan and the investor's home government. The agreement stipulates and administers the entire life cycle of renewable energy projects covering key issues such as land use rights, tariffs, grid exclusivity, minimum purchase, payment conditions and financing guaranties in power purchasing agreements (Jun, 2025). However, challenges remain in grid integration and the slow development of energy storage.Limited connectivity to

regional and extra-regional markets is a common regional challenge to ensure a secure and sustainable supply (Alparslan, November, 2024).

Uzbekistan: Rapid Reforms and International Cooperation

Uzbekistan is undergoing a significant transformation in its energy sector, marked by rapid reforms and robust international cooperation.The government has set ambitious targets to increase renewable energy capacity to 27 GW and achieve a 40% share of renewables in electricity generation by 2030 (Boute, 2019). Main various legislative measures includes the 2019 Law on Renewable Energy Sources and the Law on Public-Private Partnership, have been enacted to foster private sector participation and attract foreign investment. Uzbekistan has also engaged in numerous international partnerships, signing agreements with global entities to develop solar and wind power projects. These concerted efforts underscore Uzbekistan's commitment to a sustainable energy future through policy innovation and global collaboration.The growing population and economy are causing substantial increase in energy demand for Uzbekistan.Growing energy demand and energy intensity force Uzbekistan to unlock the huge potential of renewable energy and thus mitigate environmental impacts by reducing natural gas consumption in energy production. The energy intensity of Uzbekistan's GDP though declining in recent years, remains much higher than that of European countries (four times higher) and twice the world average. (IEA, n.d.).

Uzbekistan has the most prospective potential in wind and solar energy in the region.The technical potential of solar energy is 593000 MW and wind is 1600 MW(Aminjonov, 2020).Uzbekistan's renewable energy reforms accelerated following President Mirziyoyev's economic liberalization agenda. The Energy Strategy 2030 envisions 25% of electricity from renewables by 2030with 6% share of solar energy in the total energy mix.The Republic also envisages renewable energy export to EU via Kazakhstan and Azerbaijan by 2030 as the Presidents of Uzbekistan, Azerbaijan and Kazakhstan signed a strategic agreement on production and transmission of green energy in November 2024(Sergey, 2025).

The country has successfully attracted international investors through transparent auctions, competitive procurement, and public-private partnerships (ADB, 2021; World Bank, 2022).Uzbekistan has significantly improved the investment climate and noticeably improved indicators for ease of doing business i.e. 74th out of 190 countries in 2028 and 69th in 2019, taxation, and receiving credit (from 154th in 2013 to 55th in 2018)(IEA, n.d.). This in turn indicates improved regulatory environment conducive for business and high trust of investors. The investors from China, European countries and Gulf nations have expressed readiness to finance renewable energy projects in Uzbekistan(Sergey, 2025). China has invested in projects like the 400 MW photoelectric plant in Uzbekistan's Andijan region and the Zarafshan wind farm. Saudi Arabia's ACWA Power and Emirates' Masdar have emerged as key players in the in Uzbekistan's renewable energy development as both planning 3.1 GW and 3.2 GW prospective wind and solar power plants respectively (Kozybay, 2023).The landmark 100 MW Nur Navoi Solar Project, awarded to Masdar, exemplifies the success of reformsin renewable energy sector. The World Bank Group is also helping Uzbekistan in developing 1000 MW solar and 500 MW wind energy plants. The World Bank Group also approved $100 million concessional credit for Uzbekistan for enhancing renewable energy integration into its electricity distribution network (World Bank Group, May, 2025). Uzbekistan in collaboration with Germany has also initiated a $350 million worth solar power plant. The construction and maintenance of solar and other renewable energy plants also increase employment opportunities and stimulate economic growth in addition to clean energy, import of skill and technology and positive impact on environment.Omonov and Suyunov (2020) emphasize the role of multilateral finance, especially sovereign guarantees and viability gap funding, in mitigating investment risk.However corruption, deficiencies in innovative technologies, infrastructure gaps such as grid up-gradation, high production cost, lack of technically skilled labor force, distribution and technical losses and arid climate such as sandstorms may impede the growth of renewable energy in the country.

Table 1
Planned Renewable Energy Projects in Uzbekistan

Company	Project/Timeline	Outlook/Investments
MASDAR MUBADALA (UAE)	100 MW Solar power plant/2021	900 MY capacity / 800 million USD
TOTAL EREN (UAE)	100 MW Solar power plant/2021	150 million Euro
ASIAN DEVELOPMENT BANK	100 MW Solar power plant/2021	1000 MW capacity/800 million USD
MASDAR MUBADALA (UAE)	Wind park 500 MW	500 million USD
ACWAPOWER (SAUDI ARABIA)	Wind park 1500 MW	-
LIAONING LEADER POWER ELECTRONIC (CHINA)	Wind park 2000 MW	-
SIEMENS GAMESA (GERMANY)	Wind park 100 MW	-
ETKA CO ENERJI (TURKEY)	Wind Park 600 MW	-
ASIAN DEVELOPMENT BANK	24 MW Small hydropower facility/2023	60 million USD
EUROPEAN BANK	Refurbishing 4 small hydropower plants	100 million USD

Source: Europe-Uzbekistan Council on Economic Cooperation, "Uzbekistan Energy Overview," *Uzbek Review Market Insight Report*, October 7, 2019

Kyrgyzstan: Hydropower Dominance and Diversification Challenges

Kyrgyz Republic provides a number of incentives through the Law on Renewable Energy adopted in 2008 including tax and custom duty exemptions on import and export of relevant technology/equipments, relief from licensing on generation and guaranteed purchase of energy (IEA, n.d.). In March 2013, the Law on Energy Saving was adopted to address the issues related to efficiency.The task of developing energy efficiency and energy saving has been assigned to the State Committee on Industry, Energy and Subsoil Use. The Committee also supervises the Department of Renewable Energy Development. National Strategy for Sustainable Development 2018-2040 prioritizes energy efficient technologies for the sector (IEA, n.d.). Asian Development Bank report based on World Bank indicators has given 100 score regarding legal framework for renewables developed by Kyrgyz Republic, however only 5 score for planning the expansion of the sector(Shadrina 2019).

Small hydropower and distributed solar PV have been identified as priority areas in national energy planning (UNDP, 2022).World Bank has been undertaking and financing Renewable Energy Development Project worth $125.7 million in the Kyrgyz Republic (World Bank Group, June, 2023). First phase of the Project worth $80.2 million approved and started in 2023 and will be completed by 2028 which aims to construct new HPPs (hydro-power plants) as well as rehabilitate the existing ones for increased electricity generation and strengthen the transmission system, technical, operational, and management functions of the Ministry of Energy in the Republic (World Bank Group, n.d).The Asian Development Bank is rehabilitating the Toktogul Dam in two phases with $305 million financial assistance. The Eurasian Development Bank has been financing ($138 million) installation of Kambarata-2 hpp having a capacity of 360 MW while the Swiss government provided $22.2 million for At-Bashy hydro-power plant (IEA).

However, the lack of diversification poses risks related to seasonal variability and climate change. Yet, the literature—such as studies by Abdullaev and Rakhmatullaeva (2019) indicates persistent institutional weaknesses, including policy fragmentation, weak regulatory enforcement, and an underdeveloped private

sector. Additionally, the limited capacity of the national grid to accommodate variable renewable energy further complicates large-scale integration.Energy related infrastructure is aged, worn and therefore inefficient resulting in more than 20% losses. However energy saving potential in Kyrgyzstan is much higher. It is estimated that the Republic can save up to 25% electricity and 15% heat (IEA, n.d.).Limited access to affordable bank loans also impedes renewable energy development as the lending rate is around 20% in Kyrgyz Republic(Shadrina 2019).

Institutional Capacity and Regulatory Landscape

Across all three countries, institutional capacity and regulatory clarity are major determinants of investment outcomes. Overland and Vakulchuk (2018) argue that the investment climate in Central Asia is shaped more by governance quality than resource availability. Inconsistent application of rules, limited transparency, and political risk has hindered investor confidence, particularly in Kyrgyzstan. Nevertheless, reforms such as one-stop investment portals in Uzbekistan and streamlined permitting in Kazakhstan have improved perceptions among international investors (World Bank, 2020). The intricate tapestry of investment outcomes across Kyrgyzstan, Uzbekistan, and Kazakhstan is woven primarily from the threads of institutional capacity and regulatory clarity. While endowed with significant natural resources, the fundamental truth, as compellingly argued by Overland and Vakulchuk (2018), is that the investment climate in Central Asia is shaped far more decisively by the quality of governance – encompassing the strength, predictability, and fairness of institutions and regulations – than by the mere presence of oil, gas, or minerals. This governance gap manifests with stark consequences, particularly in Kyrgyzstan. Here, the inconsistent application of rules creates a landscape of profound uncertainty for businesses. A foreign mining company might secure permits after arduous negotiations, only to find local authorities arbitrarily reinterpret regulations or demand new, unforeseen fees months later. Coupled with limited transparency – where critical regulatory decisions or tender awards often occur behind closed doors without clear justification – and a persistent backdrop of political risk, exemplified by the volatile power shifts following the 2020 and 2022 upheavals, investor confidence has been severely hindered. This toxic combination deters long-term capital commitments, stifles job creation, and relegates the country to attracting primarily smaller, speculative ventures or resource extraction projects willing to navigate high-risk environments, leaving its broader economic potential unrealized. The tangible result is a persistent shortfall in sustainable Foreign Direct Investment (FDI), a direct casualty of institutional weakness.

Yet, the narrative across Central Asia isn't uniformly bleak. Recognizing the crippling cost of poor governance, neighboring states have embarked on ambitious reform journeys. Uzbekistan, emerging from decades of isolation, launched a sweeping transformation post-2017, explicitly targeting the bureaucratic quagmire that once defined its investment landscape. A cornerstone of this effort was the introduction of one-stop investment portals, such as the "Invest Uzbekistan" platform. Imagine a European textile manufacturer exploring expansion: previously, navigating registration, tax codes, customs procedures, and sector-specific licenses required weeks of trudging between disparate, often opaque ministries. Now, the portal offers a centralized digital interface, standardizing requirements, enabling online submissions, and providing real-time tracking. As documented by the World Bank (2020), these reforms demonstrably slashed processing times, reduced opportunities for graft by minimizing direct official contact, and introduced unprecedented levels of procedure transparency. This systemic overhaul sent a powerful signal to the international business community that Uzbekistan was serious about change, gradually rebuilding trust and positioning Tashkent as a more credible destination for diverse investments beyond its traditional resource base.

Similarly, Kazakhstan, long the region's economic leader yet burdened by its own cumbersome bureaucracy, focused its reform energy on streamlining permitting. The notorious complexity and duration of obtaining construction permits or environmental approvals were significant pain points, often cited in investor surveys as major deterrents. Initiatives like the "Business Roadmap" program targeted these specific bottlenecks, standardizing requirements, digitizing application processes, and imposing strict deadlines on regulatory bodies. A logistics company seeking to build a warehouse near Almaty, for instance, might now encounters a more predictable, albeit not perfect, pathway. The World Bank (2020) acknowledges that these efforts have tangibly improved perceptions among international investors, contributing to a more positive assessment of Kazakhstan's business environment in global indices. However, the journey is far from complete. The spectre

of corruption, particularly in procurement and inspections, and the lingering challenge of inconsistent enforcement – where well-connected entities might still circumvent rules – continue to cast a shadow. These persistent issues underscore the difficulty of embedding reform deep within institutional cultures and highlight the ongoing need for vigilance and further modernization to lock in gains and ensure a truly level playing field.

Therefore, the contrasting experiences of Bishkek, Tashkent, and Astana vividly illustrate the paramount importance of robust institutions and clear regulations. Kyrgyzstan's struggles underscore the high price of institutional fragility, while the reform trajectories of Uzbekistan and Kazakhstan, as validated by World Bank (2020) observations, demonstrate that targeted, credible actions to enhance governance capacity and regulatory predictability can yield significant dividends in improved investor sentiment and, ultimately, greater economic dynamism. The lesson for Central Asia is unequivocal: sustainable investment flows are built not just on resource wealth, but on the bedrock of effective governance.

Role of International Financial Institutions and Donor Support

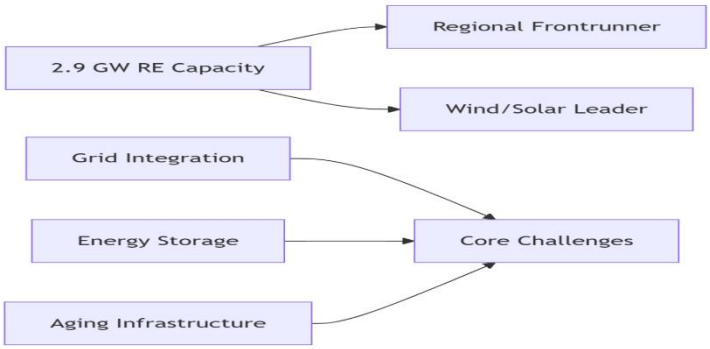
Multilateral institutions have played a pivotal role in supporting renewable energy deployment in the region. The ADB (2022) and IRENA (2020) document how blended finance, technical assistance, and project preparation facilities have enabled the design and financing of bankable renewable energy projects. The EBRD's Kazakhstan Renewables Framework and the World Bank's Scaling Solar Program in Uzbekistan are key examples. These programs not only provide financial support but also help address regulatory bottlenecks and build local capacity. The stark steppes and sun-scorched valleys of Central Asia hold immense renewable potential, yet unlocking this green energy revolution has hinged critically on the scaffolding provided by international financial institutions and donor support. For countries like Kazakhstan and Uzbekistan, transitioning from fossil-fuel dependence to wind and solar dominance presented not just technical challenges, but profound financial and regulatory chasms. Early projects often languished in a "valley of death"—too risky for commercial banks yet too complex for state budgets alone. This is where multilateral institutions stepped in as essential architects of change.

As meticulously documented by the ADB (2022) and IRENA (2020), their intervention went far beyond mere funding. Through blended finance structures—mixing concessional loans, guarantees, and private capital—they transformed speculative ventures into bankable projects. A Kazakh wind farm developer, for instance, might secure 70% commercial debt only because an ADB partial credit guarantee absorbed the risk local banks refused to shoulder. Simultaneously, technical assistance programs demystified complex grid integration studies and environmental impact assessments, while project preparation facilities covered critical pre-feasibility costs—like detailed solar irradiance mapping in Uzbekistan's desert regions—that stalled countless initiatives. Two flagship endeavors epitomize this multifaceted approach: The EBRD's Kazakhstan Renewables Framework didn't just finance 2 GW of wind and solar installations; it established standardized power purchase agreements (PPAs), trained regulators on tariff-setting methodologies, and funded retrofits for grid substations—simultaneously dismantling technical, financial, and policy barriers. Similarly, the World Bank's Scaling Solar Program in Uzbekistan functioned as a full-cycle solution. When Tashkent aimed to auction its first major solar plant, the World Bank didn't merely offer loans. It provided a ready-made competitive bidding template, handled site selection via satellite analysis, pre-negotiated grid connection terms with Uzbekenergo, and even drafted anti-corruption protocols for bid evaluation. This turnkey model slashed project development time from years to months, culminating in the successful 100 MW Nur Navoi Solar Plant—a template replicated nationwide. Critically, these programs recognized that money alone couldn't sustain progress. Embedded within each initiative were deliberate capacity-building components: EBRD engineers trained Kazakh technicians in turbine maintenance, while World Bank consultants coached Uzbek ministries on contract enforcement best practices. This knowledge transfer ensured that once foreign experts departed, local institutions could manage subsequent projects independently. The legacy of this institutional engagement is profound. By 2023, Kazakhstan's renewable capacity surged past 2.5 GW—a feat unimaginable a decade prior—while Uzbekistan's solar auctions became regional models of transparency. As the ADB (2022) underscores, multilateral support didn't just fund megawatts; it built the regulatory DNA and human capital necessary for a self-sustaining energy transition, proving that strategic donor alignment can catalyze entire green economies.

Conclusion

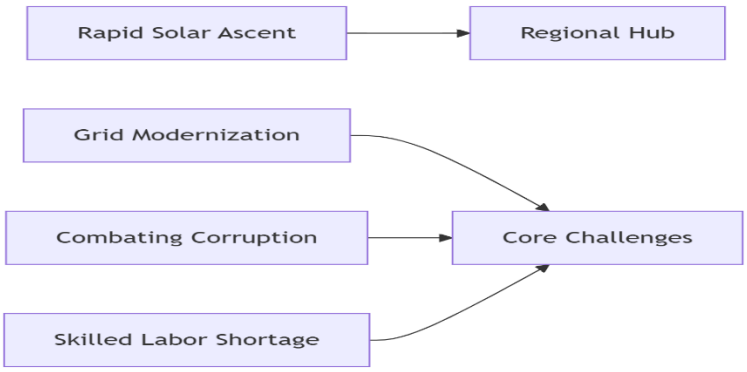
In summation, the trajectory of renewable energy investment in Kazakhstan, Uzbekistan, and Kyrgyzstan is shaped not by mere resource abundance, but by the intricate interplay of institutional capacity, regulatory clarity, and the implementation of targeted policy frameworks. Overland and Vakulchuk (2018) cogently argue that it is the quality of governance—manifested through robust institutions, consistent policy application, and heightened transparency—that serves as the true lodestar for attracting and sustaining investment, far surpassing the influence of natural resource endowments.

Kazakhstan's Energy Outlook



Kazakhstan has distinguished itself as a regional frontrunner by advancing its "Green Economy Concept" and pioneering innovative market mechanisms such as reverse auctions. These efforts have yielded substantial growth in wind and solar capacity, though the country continues to grapple with persistent challenges in grid integration and energy storage, which are critical for the next phase of its renewable transition. The catalytic role of international financial institutions cannot be overstated. Programs such as the EBRD's Kazakhstan Renewables Framework, alongside blended finance instruments championed by the ADB (2022) and IRENA (2020), have been pivotal in de-risking projects, addressing regulatory bottlenecks, and cultivating essential local capacity. Yet, the sustainability of these gains is contingent upon deeper and more enduring domestic reforms. For Kazakhstan, the imperative lies in accelerating grid modernization and developing advanced storage solutions.

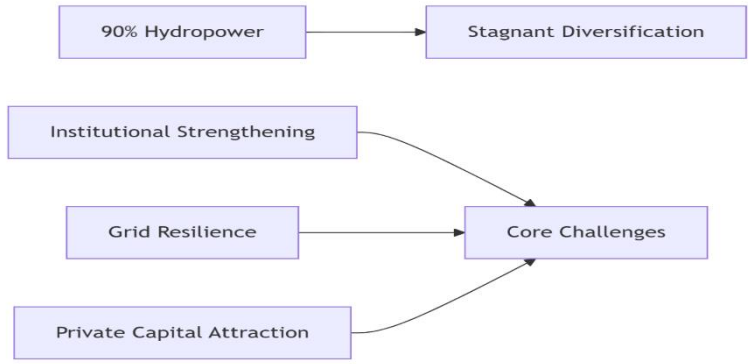
Uzbekistan's Energy Outlook



Uzbekistan's rapid ascent in the renewable energy sector further illustrates the transformative power of decisive regulatory reform. Initiatives such as the World Bank's Scaling Solar Program and strategic partnerships with global investors like Masdar and ACWA Power have been underpinned by transparent auction processes

and the establishment of one-stop investment portals (World Bank, 2020). These reforms have markedly improved the investment climate, even as infrastructural limitations and legacy inefficiencies remain. Uzbekistan needs to intensify its efforts to combat corruption and further upgrade its energy infrastructure.

Kyrgyzstan's Energy Outlook



Kyrgyzstan, meanwhile, faces an urgent need for regulatory stabilization and enhanced grid resilience to unlock its full renewable potential beyond hydropower. In contrast to Uzbekistan, Kyrgyzstan, despite its significant hydropower potential (UNDP, 2022), remains hampered by institutional fragmentation, elevated political risk, and an overdependence on a single renewable source. This has stymied diversification efforts and deterred foreign direct investment, underscoring the critical need for comprehensive institutional strengthening.

Ultimately, the prospects for a successful energy transition in Central Asia rest on the fortification of governance frameworks that guarantee predictability, equitable contract enforcement, and sustained investor confidence. Future policy agendas should prioritize regional cooperation to facilitate grid interconnectivity, bolster sub-national implementation capacity, and design context-specific risk mitigation strategies to attract a broader spectrum of private capital. Only through the consolidation of robust institutions and the articulation of coherent, forward-looking policies Central Asia can fully realize its vast renewable energy promise and secure a sustainable, resilient energy future for the region.

References

Abdullaev, K., &Rakhmatullaeva, D. (2019). Barriers to renewable energy development in Kyrgyzstan. *Renewable Energy Policy Journal*, 7(2), 99–110.

Aminjonov, F. (2020). *Renewable Energy Sources Central Asia: What should be on Agenda?*https://www.academia.edu/44074337/Renewable_Energy_Sources_in_Central_Asia_What_Should_Be_on_the_Agenda_Now

Asian Development Bank (2021). *Uzbekistan's Renewable Energy Development Roadmap.*

Asian Development Bank (2022). *Central Asia Renewable Energy Outlook.*

Boute, A. (2016). Renewable energy law and policy in Kazakhstan: Pathways to reform. *Journal of Energy & Natural Resources Law*, 34(3), 331–354.

Azimov, U.,& Nilufar Avezova. (2022). Sustainable small-scale hydropower solutions in Central Asian countries for local and cross-border energy/water supply. *Renewable and Sustainable Energy Reviews.*167 (2022) 112726. https://www.sciencedirect.com/science/article/pii/S1364032122006153

Chikanayev, S. (2022). *Renewable energy law in Kazakhstan*. https://www.academia.edu/92155569/Renewable_energy_law_in_Kazakhstan

Energy Resource Guide. (2021).https://www.trade.gov/energy-resource-guide-kazakhstan-renewable-energy

European Bank for Reconstruction and Development (2021). *Kazakhstan Renewables Framework Report.*

Gordeeva, A., Kulenova, A., &Tulegenova, D. (2022). Renewable energy investment climate in Kazakhstan. *Energy Policy*, 158, 112617.

International Energy Agency (IEA). (2022). *The Energy System of Kazakhstan 2022.* https://www.iea.org/countries/kazakhstan

International Energy Agency (IEA). (2021). *Energy Policy Review: Kyrgyz Republic 2021.*

International Energy Agency (IEA). *Kyrgyzstan Energy Profile.*https://www.iea.org/reports/kyrgyzstan-energy-profile/sustainable-development

International Energy Agency (IEA). *Kyrgyz Republic Energy Profile.*https://iea.blob.core.windows.net/assets/c71e642f-e0fd-4c9c-b910-c7adda2cf6c9/KyrgyzRepublicEnergyProfile.pdf

International Renewable Energy Agency (IRENA). (2020). *Renewable Energy Market Analysis: Central and Eastern Asia.*https://law.asia/iga-model-renewables-investment-kazakhstan/

Intentional Energy Agency (IEA. n.d.). Uzbekistan Energy Profile. Available at https://iea.blob.core.windows.net/assets/8c1cefe6-4c29-46b0-82fa-c524714e54a5/UzbekistanEnergyProfile.pdf

Kozybay, Z., (2023). In Uzbekistan, a Nascent Push for Green Energy. *The Diplomat.*https://thediplomat.com/2023/10/in-uzbekistan-a-nascent-push-for-green-energy/

Omonov, B., &Suyunov, M. (2020). The role of public-private partnerships in Uzbekistan's energy sector. *Central Asian Economic Review*, 3(2), 55–72.

Overland, I. (2011). Energy politics in Central Asia: Development and contradictions. *Journal of Eurasian Studies*, 2(2), 65–74.

Overland, I., &Vakulchuk, R. (2018). Renewable energy and geopolitics in Central Asia. *Nature Energy*, 3, 120–122.

Shadrina, E. (2019). *Renewable Energy in Central Asian Economies: Role in Reducing Regional Energy Insecurity*. Asian Development Bank Institute. https://www.econstor.eu/bitstream/10419/222760/1/1676495770.pdf

Sembayeva, A., & others. (2024). "Energy and industrial transitions in Kazakhstan", pp: 141-158 in International Energy Agency Report, *Clean Energy Innovation Policies in Emerging and Developing Economies*, *https://iea.blob.core.windows.net/assets/3fae1cd7-bb92-4d03-be7c-4e60a6f94b03/CleanEnergyInnovationPoliciesinEmergingandDevelopingEconomies-Kazakhstan.pdf*

Sukhankin,S. (27 June, 2025). "Kazakhstan Makes Final Choice on the Construction of its First NPP". *Central Asia-Caucasia Institute*, June 27, 2025,https://cacianalyst.org/publications/analytical-articles/item/13878-kazakhstan-makes-final-choice-on-the-construction-of-its-first-npp.htmlSukhankin, Sergey. (2025) Uzbekistan as a Green Energy Regional Power: Prospects and Caveats https://www.cacianalyst.org/publications/analytical-articles/item/13838-uzbekistan-as-a-green-energy-regional-power-prospects-and-caveats.html

UNDP (2022). *Renewable Energy in Kyrgyzstan: Opportunities and Challenges.*

World Bank Group (n.d.). *Powering an Energy Secure Future Across Central Asia*. https://www.worldbank.org/en/news/immersive-story/2026/02/17/powering-an-energy-secure-future-across-central-asia

World Bank Group (n.d.). *The Kyrgyz Republic to Boost its Renewable Energy Potential with Support from the World Bank and the Green Climate Fund.* https://www.worldbank.org/en/news/press-release/2023/06/28/the-kyrgyz-republic-to-boost-its-renewable-energy-potential-with-support-from-the-world-bank-and-the-green-climate-fund

World Bank Group. *Kyrgyz Renewable Energy Development Project.*https://projects.worldbank.org/en/projects-operations/project-detail/P178286

World Bank Group (2025).*Uzbekistan to Invest in Modernizing Electricity Distribution Networks with World Bank Support,* May 15, 2025. https://www.worldbank.org/en/news/press-release/2025/05/15/uzbekistan-to-invest-in-modernizing-electricity-distribution-networks-with-world-bank-support

World Bank (2020). *Doing Business 2020.*

World Bank (2022). *Uzbekistan Energy Transition Report.*

Huaping, S.; Edziah, B.K.; Sun, C.; Kwaku, A. (2019). Institutional quality, green innovation and energy efficiency. Energy Policy 2019, 135, 111002.https://ideas.repec.org/a/eee/enepol/v135y2019ics0301421519305890.html

Chen, A. (2014). Uzbekistan: The new face of energy poverty in Uzbekistan. In Pulse of Central Asia; Taylor & Francis: Abingdon, UK, Volume 1.

Shustov, A. (2019). Uzbekistan-Tajikistan: Kto Dast Den'gi Na GES? Ritm Yevrazii. Available online: https://www.ritmeurasia.org/news- -2019-04-10--uzbekistan-tadzhikistan-kto-dast-deneg-na-ges-42089?fbclid=IwAR2bRIKc-LxVN202Io_vMc6BRyo8QJdMb5sv-zMpaxy48HxWEzu3JQrgjB4

Boute, A. (2019). Energy Security Along the New Silk Road: Energy Law and Geopolitics in Central Asia; Cambridge. University Press: Cambridge, UK.

Alparslan, U. (November, 2024). *Green energy corridorsfor Central Asia and the Caucasus.*https://ember-energy.org/app/uploads/2024/11/Report-Green-energy-corridors-for-Central-Asia-and-the-Caucasus.pdf

Akhmetkali, A. (December, 2024). *Kazakhstan's Renewable Energy Sees Steady Growth in 2024, Energy Storage Challenges Persist.* Astana Times. URL https://astanatimes.com/2024/12/kazakhstans-renewable-energy-sees-steady-growth-in-2024-energy-storage-challenges-persist/#:~:text=%E2%80%9CAt%20present%2C%20148%20renewable%20energy,generation%20in%20Kazakhstan%20is%206.67%25

Jun, C. (February, 2025).*Exploring IGA model of renewables investment in Kazakhstan.*

Tursunaliyevna, Marguba Adilova and others. (March, 2025*). Renewable Energy Sources and their Impact in Central Asian Countries.* European Journal of Economics, Finance and Busness Development. URL file:///C:/Users/DELL/Downloads/4.pdf